



Environmental Policy and Technology Project

**For the New Independent States
of the Former Soviet Union**

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CENTRAL ASIAN REPUBLICS

FINAL REPORT

Delivery Order No. 6

Uzbekistan

**Potable Water Treatment Plant/Distribution System and
Public Health Improvements
for Khorezm Oblast (Urgench) and the Republic of**

Prepared for:
Bureau for Europe and the New Independent States
U.S. Agency for International Development

Prepared by:
Environmental Policy and Technology Project
A USAID Project Consortium Led by CH2M HILL

PREFACE

Under the 1992 Freedom Support Act, the United States Congress initiated a program to provide assistance to new independent states (NIS) of the former Soviet Union. Cooperative Agreements were signed between representatives of the U.S. government and each country in which assistance was to be undertaken. The U. S. Agency for International Development (USAID) was given the responsibility to coordinate all U. S. Government assistance to the NIS under the Act. The strategic objectives of USAID's assistance to the NIS were to promote:

1. Environmentally sound, sustainable economic development during the transition to a market based economy;
2. Reduction in pollution-related risks to health; and
3. Reduction of the threats to the global and regional environment.

Through competitive bidding, USAID awarded a multi-year contract to a team managed by CH2M HILL International Services, Inc. (CH2M HILL) to support implementation of an environmental assistance program to republics of the former Soviet Union. Under this contract, termed the Environmental Policy and Technology (EPT) Project, CH2M HILL was to assist USAID's missions in Moscow, Kyiv, and Almaty undertake a program to promote environmental improvements in the NIS.

The CH2M HILL team included the following organizations:

- ! Center for International Environmental Law
- ! Clark Atlanta University/HBCUMI Environmental Consortium
- ! Consortium for International Development
- ! Ecojuris
- ! Environmental Compliance, Inc.
- ! Harvard Institute for International Development
- ! Hughes Technical Services Company
- ! International Programs Consortium
- ! International Resources Group, Ltd.
- ! Interfax Newsagency
- ! K&M Engineering
- ! Ogden Environmental and Energy Services Company
- ! World Wildlife Fund (US).

The USAID mission in Almaty supports environmental, and other, assistance programs to the Central Asian Republics. CH2M HILL established an office in Almaty, Kazakhstan to manage and support activities in the Central Asian Republics under the EPT Project, including country-specific activities in Kazakhstan, Turkmenistan, and Uzbekistan and region-wide activities benefitting all five republics. As appropriate, field offices were established at specific project sites within the republics. The project's headquarters office in Washington, D.C. provided overall direction and management support for project activities in all regions.

This report was prepared as a contractually required deliverable under the contract between USAID and CH2M HILL. Although work on this report was conducted in cooperation with the assisted governments and USAID, the findings and recommendations are those of the CH2M HILL team. They do not necessarily represent official positions of the governments of the assisted countries nor of USAID.

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Section 1 Introduction

1.1 Overview of the U.S. Aral Sea Program

The Aral Sea is a major environmental disaster in Central Asia which directly affects Kazakhstan, Uzbekistan, and Turkmenistan, and indirectly the Kyrgyz Republic and Tajikistan. Thirty years ago the Aral Sea was the fourth largest inland lake in the world. Today the sea level has fallen 12 meters, the surface area has been reduced by one-half, and the salinity levels have tripled. The effects of these changes include: destroyed ecosystems; an end to commercial fishing; a dramatic decline in agricultural productivity brought on by increased soil salinity and localized climate change leading to a drastically shortened and much drier growing season; contaminated ground water; and a severe public health crisis in the areas surrounding the Aral Sea. These effects combine to create one of the world's largest environmental disasters, caused as a direct result of decisions taken during the Soviet era to focus primarily on the production of cotton and rice.

In August 1990, Senator Al Gore visited the Aral Sea region of the Central Asia Republics to witness the "impact of a poor irrigation strategy." As Vice President he has made the Aral Sea disaster zone a high priority for the United States Agency for International Development (USAID) assistance.

In March 1993, the presidents of the five Central Asian Republics met in Kyzyl-Orda, Kazakhstan and established an Interstate Council for the Aral Sea (ICAS), pledging one percent of the GDP in each country to be devoted to addressing problems of the Aral Sea. In July 1993, Secretary of State Warren Christopher recommended the execution of bilateral programs and the support of multilateral programs for international cooperation on Aral Sea projects to: provide technical support to improve water quality; address immediate public health needs; and develop effective regional water management policy mechanisms.

In October 1993, the Environmental Policy and Technology (EPT) Project contract, designed to support implementation of USAID's environmental assistance to the republics of the former Soviet Union, was awarded to a team managed by CH2M HILL International Services, Inc. (CH2M HILL). Four delivery orders for work to support the Aral Sea Program were executed under the EPT Project contract in 1994:

Delivery Order No. 2 - Potable Water System for Tashauz Oblast: Turkmenbashi Water Treatment and Dispensing System (Turkmenistan);

Delivery Order No. 4 - Predesign Activities for Potable Water Projects in the Aral Sea Basin and Environmental Action Plan (EAP Activity) (Kazakhstan and Uzbekistan);

Delivery Order No. 6 - Potable Water Treatment Plant/Distribution System and Public Health Improvements for Khorezm Oblast (Urgench) and the Republic of Karakalpakistan (Nukus) (Uzbekistan);

Delivery Order No. 7 - Potable Water Distribution System and Public Health Improvements for Kzyl Orda Oblast and the Cities of Aralsk and Kazalinsk (Kazakhstan);

Delivery Order No. 8 - Central Asian Republics: Regional Water Management and Cooperation Project (five Central Asian Republics).

Delivery Order No. 12 - *Sustainable Water Management in the Aral Sea Basin* - covering all five Central Asian Republics was awarded in 1995. This delivery order provided for the expansion of the country-specific potable water and public health and sanitation activities initiated in Kazakhstan, Turkmenistan, and Uzbekistan under Delivery Order Nos. 2, 4, 6, and 7 and for the initiation of activities specifically aimed at enhancing the sustainability of these efforts. It also provided for the expansion of the regional water management and cooperation activities initiated under Delivery Order No. 8.

Delivery Order No. 14 - *Water and Environmental Management Policy in Uzbekistan* - was awarded in 1996.

1.2 Introduction to Delivery Order No. 6

Delivery Order No. 6 (DO 6) followed from the Memorandum of Understanding (MOU) signed between the Government of Uzbekistan (GOU) and the Government of the United States of America (USAID Project No. 110-0003) on April 20, 1994. The delivery order established the contract terms between USAID and CH2M HILL for completion of the work set forth in the MOU.

The MOU was based on conclusions of a USAID team, accompanied by counterparts from the Government of Uzbekistan, that made a rapid field assessment of environmental and health problems in the Khorezm and Nukus Oblasts in December 1993. Conclusions made by this assessment team included the following:

1. There is an abnormally high incidence of infant mortality in the area. Collected and reported epidemiological data from these oblasts show high rates of morbidity attributable to the lack of potable water and poor environmental sanitation. While the infant mortality rate (IMR) for Uzbekistan is 34.8/1000, the IMR for Khorezm Oblast is 39/1000 and that for Karakalpakistan is 51.5/1000. By comparison, the IMR in the United States is 12/1000, and that in the NIS is approximately 22/1000.
2. Statistics further indicate that the population is chronically sick, particularly women and children. Rates of other sanitation-related illnesses such as non-specific diarrheas and hepatitis, particularly hepatitis A, are abnormally high when compared to western standards.
3. These morbidity and mortality rates are indicative of poor environmental sanitation (poor conditions of water supply, human waste management and other factors) observed in the region.

- 4 Although a water treatment plant exist in each oblast, it is not producing acceptable quality water.

These observations led the team to the conclusion that the most effective way to rapidly improve public health in the two oblasts was to upgrade the drinking water supply by rehabilitation of the water treatment plants, conduct public health training seminars, and provide laboratory equipment to monitor water quality. These conclusions were adopted in the MOU and formed the basis of Delivery Order No. 6.

Work begun under DO 6 was continued under Delivery Order No. 12.

This report reviews the scope of work, deliverables and major accomplishments of and lessons learned from the work carried out under Delivery Order No. 6. The body of this report contains four main sections : II. Delivery Order Objectives and Scope; III. Deliverables; IV. Major Accomplishments; and V. Lessons Learned.

Section 2

Delivery Order Objectives and Scope

2.1 Delivery Order Objectives

The objectives of Delivery Order No. 6 were:

1. To improve the quality of water produced by the existing water treatment plant in the targeted oblasts; and
2. To provide supporting activities that increase the awareness of the linkage between public health and water and to promote environmental sanitation through public health education.

2.2 Delivery Order Scope

The major elements of the scope of work for this delivery order were :

1. Upgrading of the coagulation, flocculation, sedimentation, and filtration processes at the existing water treatment plants, known as Tuyamuyun-Nukus and Tuyamuyun-Urgench water treatment plants, which draw water from the Tuyamuyun Reservoir. The scope of work included design, procurement, shipping, installation, and operator training related to the process improvements.
2. Provision of water quality monitoring laboratory equipment to the two treatment plants and to the Sanitary and Epidemiological Service (SES) laboratory in Nukus.
3. Development of public health education material and training.

The field construction equipment and the labor necessary for the installation of the equipment were provided by the Government of Uzbekistan in accordance with the MOU. Installation management, supervision and training were provided by EPT Project staff.

2.3 Project Goals and Strategic Objectives

Throughout 1996 and 1997, the EPT Project participated in the USAID Almaty Mission process of developing objectives, targets and indicators for its environmental program. The work of DO 6 was conducted under the Agency's strategic objective 3.3, "Reduced Environmental Risks in Public Health," associated with the indicators of improved reliability and availability of potable water and adoption of sound sanitation practices. Specifically, the work performed under DO 6 was linked to IRs 3.3.1 and 3.3.2 of this objective:

IRs. 3.3.1 and 3.3.2: Mitigation of negative environmental impacts of the Aral Sea disaster on local populations.

S *Indicators:* Improved: (a) reliability and availability of potable water; and (b)

adoption of sound sanitation practices.

S *Indicator definition:* Population with improved access to (a) potable water; and (b) public health education and information

S *Unit of measurement:* Number of people benefitted

IR 3.3.1.1 - USAID water supply improvement activities leverage other donor support

S *Indicators:* Other donors making significant investments into water supply and treatment infrastructure

S *Definition:* Ability of USAID to leverage other donor investments to enhance overall project impact

S *Unit of measurement:* Number of dollars invested/programmed

S *Target (Uzbekistan):* \$10 million by 1997

IR 3.3.1.2 - Water supply facilities managed on a sustainable basis

S *Indicators:* Adequate recurrent budget provided by host country government for sustained O&M of water treatment facilities

S *Indicator definition:* USAID-assisted water treatment facilities function effectively on a yearly basis

S *Unit of measurement:* Percent of O&M costs covered by local authorities

S *Target (Uzbekistan):* 25% by 1996; 75% by 1997

IR 3.3.1.3 - Water supply and treatment facilities improved

S *Indicators:* Quality, quantity and reliability of potable water increased due to rehabilitated facilities

S *Indicator definition:* USAID-assisted rehabilitation of selected water treatment facilities completed

S *Unit of measurement:* Number of improved pump stations, water wells, and treatment plants

S *Target (treatment plants, CAR):* 2 by 1997

IR 3.3.2.1 - Information on local water quality available and widely disseminated

- S** *Indicators:* Water quality monitoring and reporting improved
- S** *Indicator definition:* Labs provided with adequate equipment, training, and reagents issuing periodic reports
- S** *Unit of measurement:* Number of improved labs operating
- S** *Target (Uzbekistan):* 3 by 1997

IR 3.3.2.2 - Adequate information disseminated on public health as it relates to potable water in the Aral Sea disaster zone

- S** *Indicators:* Health education programs and public health demonstration projects increased
- S** *Indicator definition:* Areas receiving public health information and health demonstration projects
- S** *Unit of measurement:* Number of rayons and health demonstration projects
- S** *Target (raions, CAR):* 6 by 1997
- S** *Target (projects, CAR):* 20 by 1997

Section 3

Delivery Order Deliverables

Article IV - Reports /Deliverables of Delivery Order No. 6 specified the following deliverables:

3.1 Water Treatment Plant/Distribution System Improvements

- ! Continue any investigations on the water plant/distribution system improvements not completed in Delivery Order No. 4
- ! Work with the staff of the water plants and related distribution systems to modify operations to improve treatment performance
- ! Perform design work as necessary, produce procurement documents, and purchase needed equipment for the water plants and distribution system
- ! Provide operation and maintenance manuals with Russian translations for the major equipment provided for the water treatment plants

3.2 Laboratory Equipment

- ! Purchase and delivery of laboratory equipment, and training of local SES laboratory staff in proper use of delivered laboratory equipment
- ! Provision of operation and maintenance document for all equipment supplied

3.3 Health Education and Materials Development

- ! Purchase, delivery, and installation of demineralization units at selected sites in Karakalpakistan and Khorezm Oblast. Precise number and type of units to be determined based on design mission (covered under another Delivery Order)
- ! Provision of operation and maintenance document in Russian to facilitate long-term demineralization unit maintenance requirements
- ! Operation and maintenance training and public health education of staff at facilities where demineralization units are installed. (These could include, for example, hospitals, children hospitals, kindergartens and other state facilities.)
- ! Public Health Training of local SES officials, training of health education trainers, and promulgation of appropriately defined public health message through mass media.

The status of deliverables produced under DO6 is presented in Appendix A.

Section 4

Delivery Order Accomplishments

4.1 Water Treatment Plant/Distribution System Improvements

Under Task 1, performance of the Tuyamuyun-Nukus and Tuyamuyun-Urgench Water Treatment plants was further evaluated, and new U.S.-manufactured equipment was procured for and installed at disinfection, coagulation, and filtration process units at the plants to improve their operation. The ultimate goal of the task was to improve the water quality provided by the two water treatment plants.

The Tuyamuyun-Nukus and Tuyamuyun-Urgench Water Treatment plants are the most significant source of treated water for the population of the Khorezm Oblast and the Republic of Karakalpakistan in the Uzbekistan portion of the Aral Sea crisis zone. The plants draw surface water from the Tuyamuyun reservoir which was built on the Amu Darya river for irrigation purposes. Although the water is high in turbidity and has organic and inorganic contaminants, the plants were designed to treat the river water using only conventional technology based on coagulation/flocculation/sedimentation, filtration, and disinfection processes. The entire water scheme in the Khorezm Oblast and the Republic of Karakalpakistan depends on the two plants, which serves especially the population of Urgench, Nukus, and other larger settlements. The water is delivered from the plants to distribution networks via two long transmission pipelines. Both plants, located across the river from each other, are over 100 kilometers down stream from the major cities they serve. Investigations of the operation and performance of the two plants which took place during 1994 and 1995 revealed that significant deficiencies existed in the plants' operations. The performance of the two plants was substandard, and they were not able to continuously provide water of acceptable quality.

There are several reasons for which the water produced by the two plants was of poor quality including, improper design, use of poor construction practices, and installation of poor-quality process equipment at the plant during the construction of the plants. During plant operation, lack of proper equipment maintenance at the plant and poor operating practices at all process units added to the above problems. Problems with obtaining qualified labor, lack of adequate training, and lack of available financial resources were also important factors.

The plants were built in the 1980s by local construction firms following standard Soviet design. The plants were built according to a blueprint developed by a central design institute for water treatment plants in the Soviet Union and modified to local site conditions. Although the design utilized the standard water treatment processes that are widely used around the world, it discounted the presence of high water turbidity and organic and inorganic contaminants which are known to occur in the Amu Darya River water. As designed, the plants would not remove these contaminants or reduce water turbidity to acceptable levels. Additionally, the quality of construction work at the plants was very poor resulting, in concrete structures with major flaws. Among the problems were concrete bottoms at radial clarifiers which were poured with an irregular slope and prevented proper operation of sludge scraping equipment, or concrete work at the filter units which prevent even distribution of water on the filter surface. Finally, the pumping

and chemical dosing equipment installed at coagulation and chlorination units was of poor quality and technologically outdated. After construction was completed, significant operation and maintenance problems developed. Due to poor training, lack of qualified labor at the site, and insufficient financial resources, the plant's operation suffered

In order to improve the operation of the Tuyamuyun-Nukus and Tuyamuyun-Urgench Water Treatment plants, new U.S.-manufactured equipment was designed, procured, shipped, and installed at chlorination, filtration, and coagulation process units of the plants. The equipment installation was accompanied by extensive operator training, provision of spare parts and operation and maintenance tools, and development of Russian-language manuals for the new equipment.

The improvements made to the chlorination systems at the plants included design, procurement, shipping, and installation of two gas-feed systems, two liquid-feed systems, and one emergency chlorine scrubber. The improvements made to the filtration systems included design, procurement, shipping, and installation of control panels for the improved operation of the filter units. The improvements made to the coagulation system included design, procurement, shipping, and installation of two coagulation systems for the improved operation of the coagulation system.

The overall objectives of Task 1 were met through the completion of the following activities:

- ! Installation of two (2) gas-feed chlorination systems: Tuyamuyun-Urgench and Tuyamuyun-Nukus Water Treatment Plants;
- ! Installation of two (2) liquid-feed chlorination systems: Tuyamuyun-Urgench and Tuyamuyun-Nukus Water Treatment Plants;
- ! Installation of one (1) emergency chlorine scrubber: Tuyamuyun-Urgench Water Treatment Plant;
- ! Installation of control panels at filter units: Tuyamuyun-Urgench and Tuyamuyun-Nukus Water Treatment Plants;
- ! Installation of two (2) coagulation systems: Tuyamuyun-Urgench and Tuyamuyun-Nukus Water Treatment Plants;
- ! Provision of spare parts and operation and maintenance tools for the equipment;
- ! Provision of training on the operation and maintenance of the equipment;
- ! Provision of Russian-language manuals for the operation and maintenance of the equipment.

4.2 Laboratory Equipment

Under Task 2, analytical instruments, reagents, and training for drinking water analysis were provided to the institutions in Khorezm Oblast and Republic of Karakalpakistan responsible for monitoring of drinking water quality in the area. Investigations completed in June 1994 recommended provision of new laboratory equipment to replace the existing, antiquated equipment. Although the staff at each laboratory in the area was competent and qualified, the laboratory instrumentation was in a very poor state. Broken equipment and lack of supplies and reagents prevented the operators from conducting even the most basic water quality testing.

In order to improve the capability of water quality monitoring, new laboratory equipment, a supply of reagents, and training were provided to a sanitary and epidemiological service station (SES) in Nukus and to laboratories at the Tuyamuyun-Nukus and Tuyamuyun-Urgench Water Treatment Plants. The SES laboratory in Nukus is responsible for monitoring drinking water quality and ensuring that only drinking water meeting health standards is provided to the population. The laboratories at the water treatment plants monitor water quality as part of the process control and report data to the above institution. The goal of Task 2 was to upgrade and improve the selected laboratories to enable monitoring of water quality parameters which have been potentially linked to health problems in the area.

Procurement and delivery of laboratory equipment, operations training, and provision of Russian-language operation and maintenance manuals along with provision of spare parts, chemicals, and reagents took place during 1995 and 1996. The laboratory equipment, procured in the United States and delivered to the site, was specifically selected because of its ease of operation and minimal requirement for equipment maintenance. It was designed for use by analytical chemists as well as operators at water treatment plants, and featured easy-to-use instrumentation capable of detecting low level contamination, both mineral and organic. The equipment included Hach Basic Water Quality Laboratory DR 2000, laboratory and portable pH meters, laboratory and portable turbidimeters, conductivity/TDS meters, digital titrator kits, pocket colorimeters for chlorine analysis, analytical laboratories for microbiological and inorganic parameter, spare reagents, and other items necessary for extended operation.

Russian-language operation and maintenance manuals were developed and submitted for each analytical instrument provided to the laboratories. Training in equipment use was conducted at each facility, with special emphasis on testing procedures required for analysis of drinking water. The training included instruction on basic laboratory practices, water sampling, storage, and sample pretreatment, chemical and analytical procedures, and information on international guidelines on water quality.

The overall objectives of Task 2 were met through the completion of the following activities:

- ! Procurement and provision of laboratory equipment to the sanitary and epidemiological services (SES) stations in Nukus and to laboratories at the Tuyamuyun-Nukus and Tuyamuyun-Urgench Water Treatment Plants;
- ! Provision of Russian-language operation and maintenance manuals for the above

equipment and training in its use.

4.3 Health Education and Materials Development

Delivery Order No. 6 originally envisioned the purchase, delivery, and installation of an unspecified number of demineralization units at selected sites in Karakalpakstan and Khorezm Oblast under Task 3. However, based on the findings of the design mission conducted under Delivery Order No. 4, the GOU and USAID concluded that the provision of such units would not serve to achieve the objectives of Task 3 and determined that the major emphasis of this task would be the identification of major health problems in the area and the provision of health education training to key government and non-government individuals responsible for the health care at the republic and oblast levels.

A field visit was conducted in 1994 to assess the region's health problems, health improvement priorities, and needs related to water and sanitation. The report of this assessment recommended that further efforts aimed at:

- ! improving collaboration between all organizations and agencies responsible for financing, planning, implementing, and evaluating health education programs;
- ! promoting the effective use of health education methods and materials;
- ! increasing the ability of key staff members in oblast and rayon agencies in health, agriculture, and education and mass media to carry out joint needs assessments and develop and implement health education programs.

The assessment team also recommended an inter-agency planning seminar as the ideal means to assess water, sanitation, and related problems and to develop locally implemented solutions to these problems. This seminar was held in Tashkent in June 1995 for 32 representatives from health, education, and water supply agencies or institutions at the republican and oblast levels. Training provided during the seminar focused on increasing awareness of health issues by pointing to a linkage between the state of water and sanitation systems and the state of health of the local population. Eight health demonstration projects, aimed at increasing access to potable water and upgrading sanitary facilities in kindergartens and schools, farms, and factories in Urgench and Beruni, were outlined by seminar participants in collaboration with members of local communities.

Work on the engineering design and specification of equipment for these projects was initiated during visits to the demonstration project sites in late 1995. These visits also afforded the opportunity for the EPT public health team to provide mini-seminars on new approaches in health education. A health action plan, including a comprehensive training program and support for health demonstration project implementation, was proposed for implementation under Delivery Order No. 12.

The overall objectives of Task 3 were met through the completion of the following activities:

- ! Assessment of the health situation in the area;

- ! Organization of an interagency planning seminar;
- ! Development of small health demonstration projects by local communities (for implementation under Delivery Order No. 12).

Section 5

Delivery Order Lessons Learned

5.1 Objectives of the Delivery Order

As indicated earlier in Section 2, the key objectives of the delivery order were to improve the quality of water produced by the existing water treatment plants at Tuyamuyun-Nukus and Tuyamuyun-Urgench and to promote environmental sanitation and public health education. All these objectives were met with the accomplishment of the tasks under Delivery Order No. 6, as detailed in Section 4.

Although the direct health benefit of the project to the population cannot be ascertained without a detailed study of the conditions which existed prior to and post project, at the completion of Delivery Order No. 6 the water supply from the treatment plants was meeting or exceeding standards due to improvements made in the coagulation, flocculation, sedimentation, filtration, and chlorination processes. Prior to the improvements, frequently no measurable residual chlorine was detected in the water supply network. After the improvements, residual chlorine was detected in the water distribution network, which indicates that a better quality of water was now supplied to the population.

The water distribution network improved under the EPT Project does not serve the entire population of the targeted oblasts, however. There is still a significant portion of the population that does not receive good quality water, and, until the distribution system is extended to the entire population, the benefits from the improvements will be limited to those receiving the treated water. Other international donors are active in the region and have made commitments to improve public health in the area. There is reportedly a World Bank project planned to develop a reservoir at Kongrad with a 100-km pipeline to Muynak, which will provide better quality water for use with the chlorination system provided under the EPT Project (under Delivery Order No. 12). Several additional water supply projects are underway with outside assistance:

- ! A European Bank for Reconstruction and Development (EBRD) construction loan to construct a new water main from the Nukus Water Treatment Plant to the town of Beruni;
- ! A World Bank loan for a sanitation program at Samarkand and Bukhara;
- ! A Japanese grant of \$1 million to assist in the purchase of raw water pumps.

These efforts and their likely benefits notwithstanding, an overall master plan for water service improvements and the commitment of donor support for the various subprojects under the master plan would have led to a more coordinated donor effort and, possibly, to earlier and more comprehensive health benefits for the region's population.

The value of the improvements made to the water treatment system under Delivery Order No. 6 are substantial. To prolong the benefits of these improvements, plant operators were trained in the

maintenance and repair of the equipment installed, and spare parts to last approximately two years were provided under the project. To sustain the benefits of these improvements, the GOU must commit adequate amounts of financial resources, as it did during the project. This issue is equally applicable to the laboratory improvements made. The Hach equipment, as any other laboratory equipment, requires a steady supply of chemicals, supplies, and reagents that are necessary for performing required analyses. Along with the new equipment, a large stock of reagents for the most frequent analyses was provided to the three laboratories. However, the laboratories will run out of their supplies at some point, depending on the frequency of tests taken. These and other similar issues were addressed by an EPT sustainability assessment team fielded to Uzbekistan in mid-1998 and are discussed further in Section 5.3.

5.2 Water Quality Monitoring

The laboratory equipment provided to the Nukus SES laboratory and to the laboratories at the Tuyamuyun-Nukus and Tuyamuyun-Urgench Water Treatment Plants included Hach Basic Water Quality Laboratory DO 2000, laboratory and portable pH meters, laboratory and portable turbidimeters, conductivity/TDS meters, digital titrator kits, pocket colorimeters for chlorine analysis, microbiological and inorganic testing equipment, and spare reagents and other items necessary for an extended operation. This equipment will allow the laboratories to conduct the basic water quality analyses, such as pH, turbidity, total dissolved solids, chlorine, nitrate, and coliform bacteria.

The laboratories in Uzbekistan use a water quality standard of the former Soviet Union (GOST standard). Comparison of the GOST standard to the guidelines of the World Health Organization (WHO) reveals that the water quality acceptance levels specified in the GOST standards are lower than the WHO guidelines. For example, turbidity level acceptable according to the WHO standards expressed in Nephelometric Turbidity Units (NTU) is 1.0 NTU, while the GOST standard specifies 18 NTU. The Government of Uzbekistan should review the currently applicable GOST standards, and a lower turbidity value as specified in the WHO guidelines should become a target for the operation of the water treatment plants and distribution network in the area.

Local authorities might require that the instrumentation used at the SES laboratories and at the water treatment plants be certified. Although the need for certification appears to be a “hold-over” from the old Soviet system and seems to be slowly disappearing, some of the plants or laboratories might face problems with authorities when reporting analytical data generated through use of the Hach equipment. The process of certification of Hach-type equipment for Uzbekistan could be combined with a push for enforcing acceptance of more stringent requirements for water quality. We believe that a comprehensive examination of laboratory and methodology certification would eliminate some of the barriers to the adoption of advanced methodologies and more appropriate standards.

5.3 Sustainability

A project-conducted sustainability assessment of the water treatment plant improvements made more than one year after completion of these improvements found the engineering systems

installed under Delivery Order No. 6 (and Delivery Order No. 12) to be in good condition and operating as originally designed. The assessment team concluded that, overall, the Government of Uzbekistan appears to be providing the necessary resources to keep the project-provided equipment operating. Specific findings and recommendations of particular importance were:

1. Chlorination systems installed under the project are operating properly, and chlorine residuals are reportedly being maintained at all water supply facilities.
2. Chemicals necessary for the operation of the water treatment plants, such as chlorine, alum, and coagulant are available and are reportedly being supplied with little difficulty.
3. With minor exceptions, spare parts and expendable items provided by the project for two years of operation are sufficient to meet current needs. Safety equipment, spare parts, laboratory equipment, and operating manuals are being maintained at the sites.
4. Problems with currency exchange severely restrict the ability of the GOU to purchase supplies and equipment from companies outside the former Soviet Union. Spare parts and supplies for the U.S.-manufactured chlorination (and laboratory) equipment are particularly difficult to obtain. The Ministry of Communal Services is currently finalizing a supply and service contract with the U.S. manufacturer of the EPT-provided chlorination equipment. This contract is to be funded by the Government of Uzbekistan which is, apparently, keen to procure additional U.S.-manufactured equipment and services that were successfully introduced into the country under the project.
5. The water supply systems are not yet self-sustaining and require government funding. Water service collections from individual and organizational consumers cover only approximately 50 percent of the utility operating expenses. The goal of achieving full cost recovery was, reportedly, extended from 2000 to 2003.
6. The operators and other staff trained under the project have been retained, and internal training for safety and operations is conducted periodically. However, operator training is less comprehensive than that provided under the project, and training needs to be improved. While the lack of a comprehensive training program does not appear to have affected the sustainability of the project to date, there could be a significant reduction in the quality of operations as EPT-trained operators retire from the system and as the equipment ages. The service contract cited above should provide for periodic operator training on the chlorination equipment to supplement a broader GOU-provided training program.
7. Laboratory operations have been impaired by a lack of expendable supplies and some analytical instruments needing repair or service. Maintaining the laboratory equipment is difficult because the supplies and qualified services are not available locally. The currency exchange difficulty cited above aggravates the problem.
8. Fines are used to enforce the maintenance of water quality standards. This practice may encourage the operators to only report favorable test results or, possibly, to fabricate

results. Imposition of penalties for false reporting should be considered by the GOU, perhaps instead of fines for standards violations.

Appendix A
Status of Deliverables

Task	Delivery Order Deliverables	Status of Deliverables
Water Treatment Plant/Distribution System Improvements		
1	Continue any investigations on water plant/distribution system improvements not completed in DO 4	Completed. Results reported in <i>Proposed Chlorination System Improvements at Water Treatment Plants, Nukus and Urgench, Uzbekistan</i>
1	Work with the staff of the water plants and related distribution systems to modify operations to improve treatment performance	Completed. Results reported in: <i>Chlorination Operations Manual, Nukus Water Treatment Plant</i> <i>Chlorination Operations Manual: Urgench Water Treatment Plant, Uzbekistan</i> <i>Chlorination Operations Manual: Nukus and Urgench, Uzbekistan</i>
1	Perform design work as necessary, produce procurement documents, and purchase needed equipment for the water plants and distribution system	Completed. Results reported in: <i>Proposed Chlorination System Improvements at Water Treatment Plants, Nukus and Urgench, Uzbekistan</i> <i>Clarification System for the Nukus and Urgench Water Treatment Plants, Uzbekistan</i> <i>Coagulation System Design Report: Nukus and Urgench Water Treatment Plants</i>
1	Provide operations and maintenance manuals with Russian translations for the major equipment provided for the water treatment plants	Manuals provided: <i>Equipment Manual: Chlorination Equipment, Nukus Water Treatment Plant</i> <i>Equipment Manual: Chlorination Equipment, Urgench Water Treatment Plant</i>
Laboratory Equipment		
2	Purchase and delivery of laboratory equipment and training of local SES laboratory staff in proper use of delivered laboratory equipment.	Completed. Results reported in: <i>Water Quality Laboratory Training Manual Summary: Water Treatment Plant Laboratory Serving Urgench, Khorezm Oblast, Uzbekistan</i> <i>Water Quality Laboratory Training Manual Summary: Water Treatment Plant Laboratory Serving Nukus, Karakalpakistan, Uzbekistan</i> <i>Water Quality Laboratory Training Manual Summary: Sanitary and Epidemiological Services Laboratory, Nukus, Karakalpakistan, Uzbekistan</i> <i>Water Quality Laboratory Equipment Installation Program, Nukus and Urgench, Uzbekistan</i>
2	Provision of operation and maintenance documents for all equipment supplied	Manual provided: <i>Manual for Water Analyses, Hach Chemical Company</i>
Health Education and Materials Development		
3	Purchase, delivery, and installation of demineralization units at selected sites in Karakalpakistan and Khorezm Oblast. Number and type of units to be determined based on DO4 design mission.	Deleted by COTR Technical Direction that no demineralization units were needed
3	Provision of operation and maintenance document in Russian to facilitate long-term demineralization unit maintenance requirements	Deleted by COTR Technical Direction that no demineralization units were needed
3	Operation and maintenance training and public health education of staff at facilities where demineralization units are installed	Deleted by COTR Technical Direction that no demineralization units were needed
3	Public Health Training of local SES officials, training of health education trainers, and promulgation of appropriately defined public health messages through mass media	Completed. Results reported in: <i>Water and Sanitation Health Education Program, Interagency Planning Seminar: Urgench and Beruni, Uzbekistan</i> <i>Water and Sanitation Health Education Program: Health Program Summary, Urgench and Beruni, Uzbekistan</i>
Overall Project Deliverables		
All	Provision of monthly project status reports	Reports provided: <i>EPT Project Weekly Reports on Accomplishments and Issues, 1995, 1996, 1997</i> <i>EPT Project Deliverables Updates, 1997, 1998</i> <i>EPT Project Monthly Summary Reports, 1993, 1994, 1995</i> <i>EPT Project Quarterly Summary Reports, 1996, 1997, 1998</i>
All	Transportation, vehicle procurement and logistics arrangements related to the above activities	Completed

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